THE KEK-PF SLOW-POSITRON FACILITY AT A NEW SITE

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Abstract

The KEK-PF slow-positron facility was relocated to the 1.5-GeV point of the upgraded electron/positron injector linac relevant to the KEKB project. A dedicated linac for slow-positron use is also installed utilizing the remnants of the injector linac reformation. We expect a slow-positron intensity of more than 100 million positrons/sec with a maximum primary beam power of 1 kW for their application in various fields of solid-state physics.

1 INTRODUCTION

The KEK slow-positron facility, aiming at the use of slow-positron beams (ranging from eV to keV) in various fields of solid-state physics, was constructed. A slow-positron flux of $1x10^8$ positrons/sec was successfully achieved [1, 2] utilizing our 2.5-GeV electron linac [3, 4] with a 2.0-GeV, 2-kW primary electron beam power.

Although we had opened this facility to slow-positron users [5, 6], we had to relocate our facility relevant to the upgrade plan of the KEK 2.5-GeV linac. There are two major goals of the upgrade [7, 8]: 1) to increase the energy of electrons and positrons to 8 and 3.5 GeV, respectively, and 2) to increase the bunch intensities of positrons by roughly one order. In accordance with this upgrade plan, we must relocate our KEK-PF slow-positron facility to the 1.5-GeV point of the upgraded linac (the KEKB J-linac).

2 LAYOUT OF THE RELOCATED KEK-PF SLOW-POSITRON FACILITY

There are two primary-electron-beam sources for our slow positron facility; the 1.5-GeV beam of the KEKB linac and the test linac. The nominal beam power of the 1.5-GeV beam is 0.75 kW (an energy of 1.5 GeV, charge of 10 nC/pulse, a pulse length of 10 ps and a pulse repetition rate of 50 pulse/s). A dedicated linac for slow positron use only (the test linac) was installed utilizing the remnants of the J-linac upgrade plan. An average beam power of 1 kW can be expected from the test linac. A slow-positron intensity of more than 10^8 positrons/sec is easily expected in both cases.

Figure 1 shows the relocated KEK-PF slow-positron facility, which locates at the 1.5-GeV point of the KEKB J-linac. It comprises beam lines for the primary electron beams, a target-moderator assembly, a slow-positron beam-transport line and relevant assemblies.

The primary electron beam is injected into the target. The extracted slow-positron beam is directed by a 30-m long beam-transport line with an axial magnetic field of 100 G to an experimental area. Twelve sets of steering coils were installed along the slow-positron beam-transport line in order to adjust the slow-positron beam trajectory. A high-voltage station capable of applying 60 kV was installed in order to vary the energy of the positron beam. A device controller, combining a personal computer and a programmable sequence controller through optical fiber, has been adopted to control the monitors and power supplies at a high-voltage potential. Penning-trap electrodes are also installed at this station in order to make a dc beam from a pulsed beam.

At an experimental area, a slow-positron beam switch system, which comprises a pair of beam deflecting coils and two pairs of Helmholtz coils with magnetic-field directions crossing each other, was installed. This system enables us to direct slow-positron beams to several experimental stations one by one without breaking the vacuum.

As for experimental equipment, a transmission-type positron microscope, a positronium time-of-flight (TOF) apparatus, and a 2D-ACAR (two-dimensional angular correlation of annihilation radiation) equipment are now being prepared.

3 PRESENT STATUS

All components of the KEK-PF slow-positron facility were relocated. The accelerating structures and necessary magnets of the test linac have already been installed in the linac tunnel.

The commissioning of the slow positron beam was started from this April. We have already achieved a slow-positron intensity of more than 10^7 positrons/sec utilizing the 1.5-GeV J-linac beam as its primary beam source. Utilizing this positron beam, the 2D-ACAR equipment was checked and adjusted.

4 FUTURE PLAN

If we reinforce its primary beam source by adding other two accelerating units to the present test linac, we will be able to achieve a beam power of 6 kW from the upgraded test linac. This enables us to produce more than 10^9 positrons/sec in our slow-positron facility.

5 SUMMARY

The KEK slow-positron facility was relocated to the 1.5-GeV point of the KEKB J-linac relevant to the KEKB project. A dedicated linac for slow-positron use is also installed utilizing the remnants of the KEKB J-linac

upgrade plan. We have already achieved a slow-positron intensity of more than 10^7 positrons/sec utilizing the 1.5-GeV J-linac beam as its primary beam source and we expect more than 10^8 positrons/sec with a maximum primary beam power of 1 kW.

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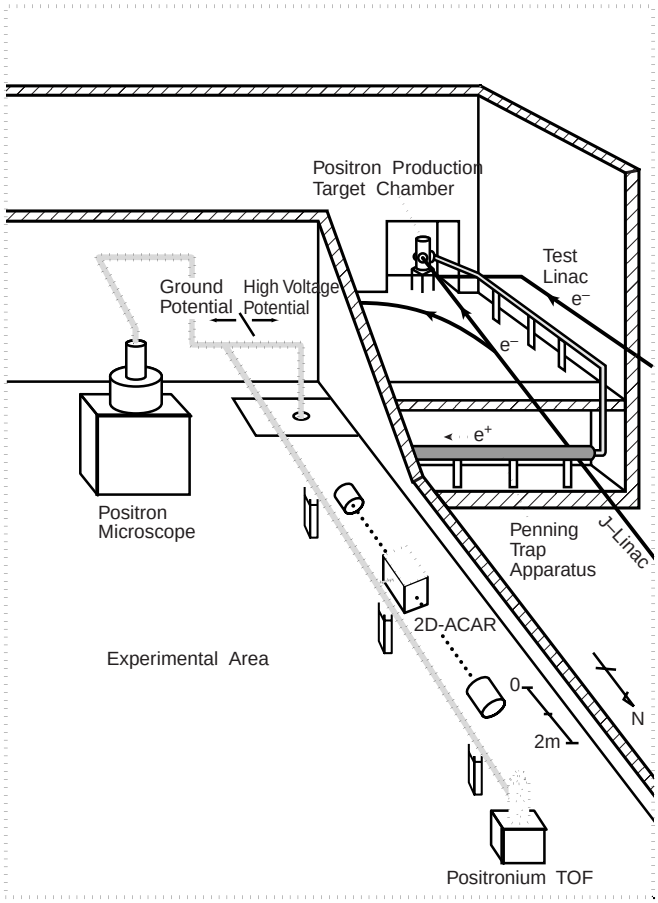

Figure 1. Bird's-eye view of the KEK-PF slow-positron facility.
It comprises beam lines for the primary electron beams, a target-moderator assembly, a slow-positron beam-transport line and relevant assemblies.